California Department of Fish and Game
Marine Region

Assessment of Seabird and Marine Mammal Impacts by the Central California Set Gill Net Fishery

Prepared for
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April 24, 2002

1.0. Summary

This document, the companion to the Director's Report required by Fish and Game Code Section 8664.7, assesses more fully the adverse impacts of the central California set gill net fishery on populations of common murres and southern sea otters. The common murre and the southern sea otter can dive deeper than 30 fathoms, the same depth at which set gill nets currently operate. The document details the distribution and abundance, mortality, and recovery efforts for each species, and, based on landing data for the six-year period 1995 through 2000, profiles the affected set gill net fishery. The document concludes that these marine resources are being adversely impacted by the continuing use of set gill nets.

1.0.1. Scope and Applicability

Set gill nets are known to take a wide variety of bycatch species (species that are not the target of the fishery). Public concern regarding the incidental take of seabirds and marine mammals in set gill nets has been ongoing for over 20 years. All evidence indicates that when set gill nets are fished in areas where common murres and sea otters are foraging, the incidental take of murres and otters will occur. Both the common murre and the southern sea otter exist in the proposed closure area.

1.1. Overview of Set Gill Net Fishery

Gill nets are single-walled nets made of multi-filament or monofilament nylon which are hung without slack and are fished for species such as white seabass, sharks, white croaker and rockfish. These fish swim into the nets and get entangled by their gills ("gilled"). When set gill nets are fished for California halibut, fishermen attach suspenders to the nets to create slack in the net. Halibut entangle or roll up in the net rather than get gilled. By definition, a set gill net with slack is a trammel net (Fish and Game Code Section 8700). Gill and trammel net fishing for California halibut is one of the oldest commercial fisheries conducted off California, beginning in the latter 19th and

early 20th centuries. However, fishermen today seldom fish for California halibut using the old three-walled trammel nets that are still defined as nets constructed with more than one wall of webbing (Fish and Game Code Section 8720). Large mesh (8.5 inch) nets used to target halibut are generally fished for 24-hour periods, and are constructed in panels about 10 to 12 feet high and 600 to 1,800 feet long. Trammel nets may not be used for the harvest of white seabass. White seabass are typically taken with set gill nets (6.5 inch mesh) set at the same time and in the same general area as halibut nets.

During the 1980s, central California was an important area for the California halibut set gill net fishery. At that time, large numbers of dead seabirds, mostly common murres, and marine mammals were noted on beaches in Monterey Bay. Subsequent investigations by the California Department of Fish and Game (Department), which included at-sea observations of gill and trammel net fishing operations in central California, identified entanglement as the principal cause of this mortality (Wendell et al. 1986). Observer data from the 1980s supported emergency regulations closing specified areas to gill and trammel nets (Wild 1990), and legislation enacted permanent closures in 1987 and 1990. Closures included the area from the Sonoma-Mendocino County line south to Point Sal, Santa Barbara County, and specified a total prohibition in the area north of Point Reyes, Marin County; in waters within three miles of the Farallon Islands; in waters 40 fathoms or less from Point Reyes south to Waddell Creek, Santa Cruz County (subsequently increased to 60 fathoms from Pillar Point, San Mateo County south to Waddell Creek, Santa Cruz County); and in waters 30 fathoms or less from Point Santa Cruz south to Point Sal, Santa Barbara County (Figure 1). State law prohibits the use of gill nets and trammel nets in that portion of District 18 north of a line extending due west from Point Sal, and in District 17 (which includes Monterey Bay), in waters 30 fathoms or less (Fish and Game Code Section 8664.5(a)-(c)); gill netting is currently permitted in all depths between Point Sal and Point Arguello, Santa Barbara County.

1.2. Statutory Context

State law provides that if the Director of the California Department of Fish and Game determines that the use of gill or trammel nets is having an “adverse impact” on any population of any species of seabird, marine mammal, or fish, the Director shall issue an order to prohibit or restrict the use, method of use, size, or materials used in the construction of either or both types of those nets in all or any part of District 10, 17, or 18 north of Point Conception (Fish and Game Code Section 8664.5(d)). This description encompasses the area from Point Reyes to Point Arguello. “Adverse impact” has two meanings. First, for purposes of this discussion, “adverse impact” means the danger of irreparable injury to, or mortality in, any population of any species of seabird which is occurring at a rate that threatens the viability of the population as a direct result of the use of gill nets or trammel nets (Fish and Game Code Section

8664.5(e)(1)). Specifically, the issue is adverse impacts to the common murre, a seabird that is listed under the Migratory Bird Treaty Act, and is additionally protected under Fish and Game Code Section 3513. Second, for purposes of this discussion, "adverse impact" also means the impairment of the recovery of a species listed as an endangered species or threatened species pursuant to the federal Endangered Species Act (ESA) or the California Endangered Species Act, or a species of marine mammal designated as "fully protected" under the Fish and Game Code, as a direct result of the use of gill nets or trammel nets (Fish and Game Code Section 8664.5(e)(2)). Specifically, the issue is adverse impacts to the southern sea otter, a marine mammal that has been listed as "threatened" under the federal ESA since 1977, has been the subject of a Recovery Plan since 1982, and is "fully protected" pursuant to Fish and Game Code Section 4700. The southern sea otter is also considered "depleted" under the Marine Mammal Protection Act.

1.3. Finding of Adverse Impacts

The common murre of central California ranges from Point Reyes to southern California and can dive to 98 fathoms (180 meters; 590 feet) (Piatt and Nettleship 1985). The populations are estimated to be between 7 and 22 percent of historical levels, based on estimates (Carter et al. 2001) that the South Farallon Island colony alone numbered between 1 and 3 million birds in the early 1800s. Although the common murre is subject to various restoration and management actions, mortality from set gill net entanglements continues to exacerbate the serious impediments to restoration faced by this species. The southern sea otter ranges from Half Moon Bay, San Mateo County to just below Point Conception, Santa Barbara County and can dive to 36 fathoms.[1] The southern sea otter population is currently static, and although it is the subject of state and federal protection, set gill net entanglements continue to exacerbate the serious impediments to recovery faced by this species. Based on these considerations, the Department concludes that, as a direct result of set gill nets, the danger of irreparable injury to, or mortality in, the central California population of common murre is occurring at a rate that threatens the viability of the population, and that the recovery of the southern sea otter is impaired.

2.0. Status of Impacted Resources

2.1. Common Murre

[1] **Researchers have documented sea otter dives in Alaska to 55 fathoms (J. L. Bodkin, U.S. Geological Survey (USGS), pers comm.). Although these otters are a different subspecies than the southern sea otter, the two are physiologically indistinguishable, so the latter could be expected to have the same capabilities.**

2.1.1. Distribution and Abundance[2]

The common murre (*Uria aalge*) is a large, diving seabird that is circumpolar in its distribution in the northern hemisphere (Gaston and Jones 1998). The common murre, which weighs about one pound and superficially resembles a penguin, is a long-lived species (up to 25 years) with low annual productivity (an average of less than one fledgling per year). Two subspecies are currently recognized along the Pacific coast of North America: the northern subspecies (*Uria aalge inornata*) ranges from northeastern Asia to Alaska, and the southern subspecies (*Uria aalge californica*) ranges from British Columbia to California (Manuwal and Carter 2001).

In California, the southern subspecies of common murre currently breeds along the coast and offshore rocks and islands from the northern California border to central California (Carter et al. 2001). Ten colonies are found in the central California counties of Marin, San Francisco, San Mateo, and Monterey, on offshore rocks and nearshore rocks and mainland cliffs (Figure 1). The colony complex located off Big Sur in Monterey County (Castle Rock/Hurricane Point) is the southern most limit of breeding for this species in the eastern Pacific. A breeding colony that formerly existed on Prince Island, Channel Islands, was extirpated in the early 1900s. Common murres range as far south as the Channel Islands in southern California (Manuwal and Carter 2001).

The most recent available estimates of the breeding population sizes of the 10 central California colonies are from aerial survey data from 2000 (M. W. Parker, USFWS, unpublished data). These preliminary numbers indicate a total of 218,040 adult breeding birds. The preliminary 2000 numbers for the colonies are as follows. The largest numbers occur in San Francisco County at the two offshore colonies of the South and North Farallon islands (about 20 to 30 kilometers from the mainland), with estimates of 165,373 birds for the two colonies combined (76 percent of the central California population). The next largest colony of 36,202 breeding birds (16.6 percent of central California population) is at Point Reyes, Marin County, on nearshore rocks and mainland cliffs. Just south of Point Reyes are three small colonies (Point Resistance - Double Point complex, also known as the Drake's Bay complex) on nearshore rocks totaling 13,626 breeding birds (6.2 percent of the central California population). About 50 kilometers further south, two isolated colonies (Devil's Slide complex) occur in San Mateo County on a nearshore rock and mainland cliffs with 196 breeding birds at Devil's Slide Rock. The last two colonies are found about 150 kilometers south of the San Francisco area colonies. The isolated Castle Rock - Hurricane Point colony complex, located 15 kilometers south of Yankee Point,

[2] **All population estimates are based on preliminary numbers from aerial surveys conducted in 2000 by the U. S. Fish and Wildlife Service (USFWS) (M. W. Parker, USFWS, unpublished data).**

Monterey County, consists of an estimated 2,643 breeding birds (1.2 percent of the central California population) on nearshore rocks and mainland cliffs.

Central California common murre numbers declined an estimated 52.6 percent between 1980-1982 and 1986 due in large part to mortality in set gill nets and oil spills, and low breeding success during a severe El Niño-Southern Oscillation event

(Takekawa et al. 1990, Carter et al. 2001). Central California colony population numbers increased in the 1990's, but are still substantially lower than historical levels.[1]

The common murre breeding season in central California extends from late April to early August (Manuwal and Carter 2001). Adult murres have a strong tendency to return to and breed at the same colony where they were born. Once a murre starts breeding, between the ages of four and seven, they usually return to the same breeding site each year. As a result, pair-bonds persist for many years. While some inter-colony movement does occur, individuals rarely move to another colony (Gaston and Jones 1998). During the breeding season, the foraging range of breeding birds becomes restricted close to their colonies so that they can attend their eggs and chicks. Chicks depart ("fledge") the colony in central California between June and October. The flightless chicks, which are about one-fourth adult size, are accompanied by the adult males. The parent protects and feeds the dependent chick for one to two months, in shallow nearshore waters (Manuwal and Carter 2001). In winter, murres disperse along the coast and forage between the coastline and the outer parts of continental shelf. They are still most commonly found in inshore waters, foraging at midwater depths. Manuwal and Carter (2001) estimated that one-third to one-half of the central California population depends upon Monterey Bay for forage in the late summer and early fall.

In central California, common murres are extremely vulnerable to human activities that cause major local population declines, such as mortalities due to net entanglement and oil spills. It is more difficult for murres in central California to recover from these impacts because they return to their birth colony to breed, adults are year-round residents, and the populations are geographically separate from other populations. Especially during the breeding and chick-rearing periods, the majority of murres found in these waters would be expected to be from the central California population. The small colony numbers at the Devil's Slide complex and the Castle Rock/Hurricane Point complex make them particularly susceptible to colony declines and extirpation from human activities within their breeding and foraging range.

Data compiled from 1981 to 1998 by the Minerals Management Service on the distribution of murres between Point Buchon and Point Conception showed a number of birds inside the 55 to 109 fathom contour lines. These waters are particularly important to murres in the late summer, fall and winter, and are more likely to support murres from the at-risk Big Sur coast colonies due to their proximity. The area from Point Sal to Point Arguello is the location of the 1997 *Torch/Platform Irene Pipeline* oil spill. In response to that spill, the Department conducted aerial surveys of seabirds in late September and early October. At that time, murres were one of the most abundant

[1] **For example, the South Farallon Islands colony was estimated to have numbered between 1 to 3 million birds in the early 1800s (Carter et al. 2001).**

seabird species within one to two miles from shore, with the greatest concentration

occurring just off Point Sal, and were the most abundant species among the stranded birds collected during the spill (Ford Consulting Company 1998).

2.1.2. Mortality

Common murre mortalities due to entanglement in set gill nets and oil spills have been identified as key factors that have prevented recovery at central California colonies to levels reached from 1979 to 1982 (Boekelheide et al. 1990; Takekawa et al.1990; Carter et al. 1995, 2001; Sydeman et al. 1997; McChesney et al. 1998, 1999). The common murre has experienced declining populations in central California in the past decades to levels that are estimated to be between 7 and 22 percent of historical levels. The most severe population declines have occurred at colonies which are located nearest to areas of highest set gill net mortality (Carter et al. 2001). Large numbers of dead seabirds (mostly common murres) and marine mammals were noted on beaches in Monterey Bay during the early 1980s, which coincided with set gill net activity. During the 1980s, central California was an important area for the California halibut set gill net fishery and at least 70,000 common murres are estimated to have died in set gill nets in that period (Takekawa et al. 1990). Area closures for set gill nets in the 1980s were intended in part to reduce the take of seabirds.

Survey data shows that, in Monterey Bay from July through September 1999, 30 percent of the murres were dependent chicks (S. Benson, Moss Landing Marine Laboratories (MLML), pers. comm.). Murres collected during the National Marine Fisheries Service (NMFS) observer program in 1999 indicated that adult males outnumbered females by about eight to one among birds drowned in set gill nets in August and September (H. Nevin, MLML, pers. comm.). These findings are similar with past studies that found a majority of murres killed in set gill nets to be males (Takekawa et al. 1990). The adverse effects of net entanglements on the common murre population is compounded during the time of year when adult males care for the chicks. If the adult male is killed, the dependent chick is also likely to die from lack of parental care and feeding (Takekawa et al. 1990).

From 1980 to 1989, 5,271 seabirds were observed caught in set gill nets in the area from the Sonoma-Mendocino County line south to Yankee Point (Wild 1990), with an average rate of seabird entanglement of 2.6 birds per observed net set. The majority (88.3 percent) of these observed nets were large-mesh set gill nets fished for California halibut; the remainder were small-mesh nets fished for white croaker (Wild 1990). From 1990 to 1994 and 1999 to 2000, the comparable rates of entanglement were 2.6 birds per observed halibut net set and 0.4 birds per white seabass/shark net (using 6-7 inch mesh gill net) (K. A. Forney, NMFS, pers. comm.). From 1983 to 1985, the rate of seabird entanglement in large mesh nets fished for California halibut in the Morro Bay/Avila area was 0.1 birds per observed net set (U.S. Marine Mammal Commission (USMMC), unpublished report). A total of 94 seabirds was observed

caught in 808 large mesh nets in this area (USMMC, unpublished report). Common murres accounted for 50 to 97 percent of the total fishery related seabird mortality from 1980 to 1986, and at least 70,000 common murres were drowned in large and small mesh gill and trammel nets between 1979 and 1987 (Takekawa et al. 1990). In the Morro Bay area, there were observed mortalities during the 1990 through 1994 observer program, yielding an average entanglement rate of 0.943 murres per set (Forney, Benson and Cameron 2001). In combination with natural mortality and mortality associated with oil spills and El Niño effects, this level of set gill net mortality was high enough to contribute to a large decline in abundance of the central California breeding population of common murres (120,550 out of 229,080 murres in this population were lost between 1980 and 1986) (Takekawa et al. 1990).

From July 1990 to December 1994, a NMFS observer program generated seabird data on drowning associated with the set gill net fishery for halibut and angel shark in southern and central California. A total of 880 common murres were observed entangled, 99 percent north of Point Conception and predominantly in the Monterey area (Julian and Beeson 1998). The NMFS estimated that a total of 7,964 common murres were drowned in large and small mesh gill and trammel nets during that period (Julian and Beeson 1998). From 1995 to 1998, no observer program existed for this fishery, but based on historical data and annual estimates of 1995 to 1998 fishing effort, Forney et al. (2001) statistically estimated the range of total murre mortality for this period to be 5,918 to 13,060 birds, depending on the assumptions made.

In 1999, a reinstated NMFS observer program in Monterey Bay covered 23 percent of fishing trips and observed 498 dead common murres, resulting in a statistically-based mortality estimate of 2,359 murres for the period of January through December 1999 (Cameron and Forney 2000). In addition, approximately 560 dependent chicks are likely to have died as a result of the death of the male parent (NMFS, unpublished data, K. A. Forney pers. comm.). In 2000, the NMFS observer program in Monterey Bay covered 27 percent of the fishing trips and observed 711 dead common murres, resulting in a statistically-based mortality estimate of 3,141 murres for the period of January through August 2000 (Carretta 2001). This estimate of common murres taken in set gill nets in 1999 and 2000 represents a level of mortality that threatens the viability of the population and impairs the recovery of common murres as a direct result of the use of gill and trammel nets. The combined 1999 to 2000 mortality of an estimated 6,000 birds in Monterey Bay alone caused by the halibut set gill net fishery potentially jeopardizes the existence of small colonies at Devil's Slide Rock and Castle Rock - Hurricane Point, and causes noticeable long-term impacts at large colonies at the Farallon Islands and Point Reyes. The estimated take of 6,000 murres represents over 200 percent of the nearby Castle Rock-Hurricane Point population, which was estimated to support 2,643 breeding birds in 2000. In respect to the ten central California populations, 6,000 murres represents about 2.8 percent of the population estimate for the year 2000. We are not able to estimate the actual local

population impact but it is likely much greater than the impact on the central California population as a whole. Because of the relatively small size of the local population, combined with the fidelity of the murre for its home colony, it is highly questionable that the current level of take of the common murre in the central California set gill net fishery is sustainable. The loss of birds to oil spills further compounds the situation for the Big Sur common murre population. All evidence indicates that when set gill nets are fished in areas where common murres are foraging, the incidental take of murres will occur.

Oil spills are also a major source of common murre mortality. The 1986 *Apex Houston* oil spill affected beaches from Point Reyes to Monterey and killed approximately 9,000 seabirds, including 6,000 common murres. Several seabird breeding sites were impacted, including the colony at Devil's Slide Rock, just south of San Francisco, which was abandoned by common murres after the spill. The 1998 *T/V Command* oil spill near Half Moon Bay resulted in an estimated 3,000 common murre mortalities. Since November 2001, an oil spill, recently discovered to be from a sunken vessel, has been occurring intermittently along the central coast near San Mateo, with oiled seabirds found on beaches between the Farallon Islands, Point Reyes and Monterey Bay, with a few as far south as Morro Bay. A similar spill (possibly from the same sunken vessel) in 1997 and 1998 resulted in an estimated 10,000 birds killed. As of March 2002, the total number of oiled birds found along the central coast near San Mateo has been over 1,866 with 90 percent of these identified as common murres. Based upon carcass recovery rates from past oil spills, many thousands of common murres are assumed by the Department to have died from this single spill.

2.1.3. Recovery Efforts

During the 1980s, central California was an important area for the California halibut set gill net fishery. At that time, large numbers of dead seabirds, mostly common murres were noted on beaches in Monterey Bay. Set gill net entanglement was the principal cause of this mortality. Observer data from the 1980s supported emergency regulations closing specified areas to gill and trammel nets and legislation enacted permanent closures in 1987 and 1990. Subsequently, the distribution of set gill net fishery effort changed in some areas and again large numbers of dead seabirds were noted on beaches (Forney et al. 2001). To protect both seabirds and marine mammals, emergency regulations restricted the use of gill nets in waters 60 fathoms or less from Point Reyes to Yankee Point and from Point Sal to Point Arguello in 2000 and 2001.

Due to the tenuous status of the central California population and the fact that they are the most common mortalities in oil spills, common murres are often the subject of oil spill natural resource damage assessment and restoration actions (Page and Carter 1987, Page et al. 1990). The Department and other natural resource trustees

for the 1986 *Apex Houston* oil spill are spending $5 million from the 1994 settlement to restore the Devil's Slide Rock and San Pedro Rock colonies.[1] Now in its sixth year, the project has been partly successful in reestablishing the Devil's Slide Rock colony, but the viability of that population is jeopardized by continuing set gill net mortalities. The recent settlement of the 1998 *T/V Command* oil spill case was largely based on an estimated 3,000 common murres as the preliminary assessment of mortality. The trustee agencies settled for $4 million in natural resource damages and have targeted approximately $2.85 million of this settlement for restoration projects benefitting seabirds, particularly the common murre. As discussed above, the area from Point Sal to Point Arguello is the location of the 1997 *Torch/Platform Irene Pipeline* oil spill. The Department and other trustee agencies are currently negotiating a settlement of natural resource damages in this case and have proposed a $1.8 million seabird project for this area. Seabird researchers suggest that natural recovery of the central California population to 1979-1982 levels may require "at least another decade without additional major detrimental effects" (Carter et al. 2001).

2.2. Southern Sea Otter

2.2.1. Distribution and Abundance

The southern sea otter (*Enhydra lutris nereis*), the smallest species of marine mammal in North America, inhabits a narrow band between the shoreline and nearshore waters, preferring rocky habitat with kelp beds. Preliminary results from research in California and Alaska using Time-Depth Recorders confirms that sea otters make foraging dives to depths greater than 30 fathoms. Dives to 36 fathoms have been recorded in California and to 55 fathoms in Alaska (J. L. Bodkin, USGS, pers. comm.). In California, sea otters currently range from Half Moon Bay to just below Point Conception (B. B. Hatfield, USGS, unpublished report). The number of sea otters existing in California before the beginning of the fur trade era in the mid-1700s was estimated at 16,000 (Laidre et al. 2001). By the early 1900s, the population was estimated to have been reduced to 50 to 100 otters (VanBlaricom et al. 2001). Distribution and abundance of the sea otter in California have been of continuing interest since the discovery of approximately 50 animals at Bixby Creek on the Big Sur Coast in 1911. Following the initiation of conservation measures, the sea otter population in California grew until the 1970s. The population may have declined from the late-1970s to the early-1980s.

Since 1982, the USGS and the Department have conducted spring and fall sea otter surveys using the same methodology (aerial and ground counts). However, due

[1] **The Devil's Slide Rock colony was extirpated in large part because of set gill netting and the 1986 spill, and the San Pedro Rock colony had been extirpated by egg collectors in the early 1900s.**

to sea otter range expansion, increasingly larger portions of the range are aerially surveyed. Comparisons between aerial and ground counts have shown that the aerial survey method counts on average are approximately 70 percent of the ground survey counts (M. D. Harris, CDFG, pers. comm.). Spring surveys are consistently higher than the fall surveys in any given year and are less variable among years (Estes and Hatfield, USGS, unpublished report), due to the more favorable seasonal conditions (J. A. Ames, CDFG, pers. comm.). Spring counts peaked in 1995 at 2,377 individuals, declined and then peaked again in the spring 2000 survey at 2,317 individuals. The spring 2001 survey counted 2,161 individuals along the coast from Half Moon Bay to Point Conception, 6.7 percent below the spring 2000 survey (B. B. Hatfield, USGS, unpublished report) (Figure 2 and Figure 3). According to the USFWS, the spring counts suggest that the population increased from the mid-1980s to the mid-1990s at about 5 percent per year then declined by about 10 percent from the mid- to late-1990s (USFWS 2000). Trends since 1999 are not as clear, since the ability to infer population trends from count data is weakest over short-time intervals and when count data are highly variable between years. In addition, a colony at San Nicolas Island in the Channel Islands, originally consisting of 140 sea otters translocated from 1987 through 1990, contained at least 28 individuals at last count in December 2001 (B. B. Hatfield, USGS, pers. comm.). The California population has apparently increased at a slower rate (4 to 6 percent per year) than most other sea otter populations of the Pacific coast (17 to 20 percent per year) according to Estes and Hatfield (USGS, unpublished report). Despite these fluctuations in numbers, the sea otter population in California has exhibited a gradual increase in its range (Figure 4). In 1995 sea otters expanded their range into the area between Point Sal and Point Arguello where there are no set gill net fishery depth restrictions; between 1995 and 2001, sea otter counts south of Point Sal ranged from a low of 12 (spring 1996) to a high of 187 (fall 1998). The spring 2001 survey counted 22 sea otters between Point Sal and Point Arguello (B. B. Hatfield, USGS, unpublished report).

2.2.2 Mortality

Information on sea otter mortality in California is based on recovered carcasses and stranded animals that do not survive. From 1968 through 1991 the Department and the USFWS conducted a dead sea otter salvage and necropsy program that consisted mainly of field necropsies and the gathering of basic life history data (e.g., location found, length, weight, and sex). Several sources of mortality due to human activity were documented during this period, including entanglement in fishing gear, boat collisions, propeller strikes, and shootings.

In the 1970s, there was evidence of a decline in the sea otter population and an increase in the number of carcasses recovered (Wendell et al. 1986). A Department observer program on set gill net vessels documented the incidental take of sea otters. Wendell et al. (1986) estimated annual mortality of sea otters in the set gill net fishery

by expanding the average rate at which drowned otters were observed in set gill nets over the period from June 1982 through June 1984. The mean estimated take, from three observed mortalities, was 80 otters per year during the study period. Herrick and Hanan (1988) estimated the incidental take of sea otters from 1973 to 1983 based on the relationship between the number of landings from the fishery and mortality estimates from Wendell et al. (1986). The estimated mortality for 1973 through 1983 ranged from 48 to 166 otters annually, with an average of 103 mortalities per year. Regulations restricting the use of gill and trammel nets by closing areas and by progressively increasing depth restrictions greatly reduced mortalities (Wendell et al. 1986, Wild 1990). Three sea otters were observed taken in set gill nets set at depths greater than 30 fathoms in 1990 in the Morro Bay area (Julian and Beeson 1998). No sea otter takes were reported between 1991 and 1994, when fishing north of Point Sal was restricted to a minimum depth of 30 fathoms. Changes in the fishery after 1994 raised renewed concern over potential bycatch of sea otters in set gill nets in central California. Based on historical data and annual estimates of 1995 through 1998 fishing effort, Forney et al. (2001) statistically estimated the range of sea otter mortality for this period to be 17 to 125 individuals depending on the assumptions made.

In 1999, the reinstated NMFS observer program in Monterey Bay documented the take of 1 sea otter, 27 harbor porpoises, 13 California sea lions, 10 northern elephant seals, and 57 harbor seals during the observed 23 percent of all halibut set gill net fishing trips during calendar year 1999 (Cameron and Forney 2000). All of these marine mammals are protected under the MMPA. The central California harbor porpoise is classified as a 'strategic stock' under the MMPA because of the high mortality rate in this fishery (Forney pers. comm.). Recent monitoring by NMFS at-sea observers documented marine mammal mortalities in those areas where closures extended only out to 30 fathoms.

In 1999, the estimated take in the set gill net fishery was 5 sea otters (Cameron and Forney 2000). Between March 1999 and January 2000, 12 sea otter surveys were conducted off south Monterey Bay, including deep water areas (30 to 50 fathoms) where set gill netting for halibut occurs. The number of otters observed in deep water ranged from zero to 13. Otters foraging at these depths are vulnerable to entanglement and drowning. In 1999, the one sea otter observed incidentally taken was in a net set at 31 fathoms (Forney et al. 2001). All evidence indicates that when set gill nets are fished in areas where sea otters are foraging, the incidental take of sea otters will occur. No level of take is allowed. The incidental take of sea otters in the central California set gill net fishery has been documented repeatedly by observer programs in the both the 1980s and 1990s.

In the 1992 *Avila Beach Pipeline* oil spill, two otters died and three were rehabilitated (USFWS 1997). Since 1992, an intensive investigation into the causes of sea otter mortality in California has occurred. Virtually every fresh dead sea otter

receives a detailed necropsy by a veterinary pathologist. Exposure to environmental contaminants may cause immune system deficiencies that lead to increased mortality or decreased reproduction in sea otters. Several new disease agents and disease processes have been described for otters in California and some of these may be directly or indirectly the result of human activity. These newly described diseases include protozoal encephalitis, acanthocephalan peritonitis and bacterial infections (Thomas and Cole 1996, M. A. Miller, University of California, Davis (UCD), pers. comm.). Recently, samples of sea otter digesta and fresh scats have shown that sea otters harbor a variety of potentially pathogenic bacteria and protozoa, many of which may be directly or indirectly of human origin (M. A. Miller, UCD, pers. comm.). Infectious diseases and parasites have been identified as the ultimate cause of death in about 40 percent of recovered carcasses (Estes and Hatfield, USGS, unpublished report). Between 1997 and 2000, 888 otter carcasses have been recovered along the coastline (B. B. Hatfield, USGS, pers. comm.). Given that the total otter population at any one time is probably well below 3,000 animals, this appears to be a high rate of mortality, especially considering that 40 to 60 percent of the otters that die are probably never recovered (J. A. Ames, CDFG, pers. comm.). These findings along with the cessation of population growth for the past several years, highlight the precarious status of the southern sea otter population in California.

2.2.3. Recovery Efforts

During the 1980s, central California was an important area for the California halibut set gill net fishery. At that time, dead otters were noted on central California beaches. Set gill net entanglement was discovered to be one of the principal causes of this mortality. Observer data from the 1980s supported emergency regulations closing specified areas to gill and trammel nets and legislation enacted permanent closures in 1987 and 1990. Subsequently, the sea otter's range extended south of Point Sal. In the area from Point Sal to Point Arguello there were no depth restrictions on set gill nets. To protect both seabirds and marine mammals, emergency regulations restricted the use of gill nets in waters 60 fathoms or less from Point Reyes to Yankee Point and from Point Sal to Point Arguello in 2000 and 2001.

The USFWS has management authority for sea otters. Under the ESA, the goal of management is to recover the population to a point where it is not considered endangered or threatened and to restore listed species so as to ensure their persistence in the wild. Since 1982, several recovery plans and revised draft recovery plans for the southern sea otter have been written. A Revised Recovery Plan was completed in 1995 and two approaches were identified that would lead to delisting the southern sea otter under the ESA: (1) increase the range of otters in California to reduce the risk of a single oil spill event reducing the otter population below a level that is viable, and (2) decrease the risk to otters that a major oil spill event within their range will occur (USFWS 2000). In 2000, a Draft Revised Recovery Plan was published that

increased the recovery priority from a subspecies with a moderate level of threat but having a high potential for recovery (recovery priority of 9C) to a subspecies with a high degree of threat and low potential for recovery (recovery priority of 6C).[1]

In a 1999 letter to the USFWS Director, the Executive Director of the Marine Mammal Commission made several observations about southern sea otter recovery, including (1) that the attempt to establish a reserve sea otter colony at San Nicolas Island has been unsuccessful for reasons that have not been identified; (2) that the mainland sea otter population appears to have been declining since 1995 for reasons that are not clear; and (3) that given uncertainty concerning the cause or causes of population decline and the movement of otters into the management zone south of Point Conception, capturing and returning otters to the parent population, should large numbers of otters move south into the management zone again next spring, could have negative impacts on the population.[1]

Due to the recovering status of the population and the fact that the southern sea otter is federally protected under ESA and "fully protected" under state law, the southern sea otter is often the subject of oil spill natural resource damage assessment and restoration actions.

3.0. Status of Set Gill Net Fishery

3.1. Overview

Set gill nets are used to target a number of different species including halibut, white seabass, sharks, white croaker and rockfish. Set gill nets are also known to take a wide variety of bycatch species. Public concern regarding the incidental take of seabirds and marine mammals in set gill nets has been ongoing for over 20 years. In the early 1980s, this concern resulted in legislative action to close certain areas to the use of gill and trammel nets in central California nearshore waters (Haseltine and Thornton 1990). Consequently, an Alternative Gear Development program was developed to investigate alternative gear types for the take of California halibut and

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[1] **The "C" in the priority indicates that recovery of the species may be in conflict with development projects or activities. Specifically, the recovery of the southern sea otter under the ESA could potentially conflict with several state managed fisheries in California, as well as the transport and extraction of oil and natural gas products along the coast of California (USFWS 2000).**

[1] **The management zone was created on November 7, 1986 when the U.S. Congress enacted Public Law 99-625 which authorized the translocation and management of sea otters in California. The management (otter-free) zone surrounds the translocation zone (waters surrounding San Nicolas Island) and includes waters from Point Conception south to the U.S./Mexican border.**

white croaker (Haseltine and Thornton 1990). The study was conducted from 1986 through 1988 in central California. Gear tested for the take of halibut were otter trawl, Scottish seine, pair trawl, beam trawl, traps, bottom longline, and troll gear (Haseltine and Thornton 1990). All tested gear types did not appear to seriously threaten seabird or marine mammal populations. Only otter trawls caught halibut at a rate economically approaching or exceeding gill and trammel nets. The use of otter trawls is statutorily precluded by Fish and Game Code Section 8606.1.

3.1.1. Landings

During 1995 through 2000, statewide commercial California halibut landings averaged 1.05 million pounds. This amount of harvest has been sustainable and the halibut resource is considered healthy. Current regulations, which include a 22-inch minimum size limit, depth restrictions on trawl and set gill net gear, 8.5 inch mesh sizes for set gill nets, and a sport limit, appear to be effective management measures. Set gill net landings of halibut in central California have not been sampled for biological information such as size, age, sex or maturity. Information reported here is from Fish and Game landing receipts. Information recorded on landing receipts includes fisherman identification, vessel identification, date of landing, port of landing, Fish and Game Fishery Block (FG Block) fish were caught in, market category of fish, pounds, and price per pound. FG Blocks vary in size. One, denominated by a three-digit code, is 10 x 10 nautical miles; another, also denominated by a three-digit code, is 30 x 40 nautical miles; a third, denominated by a four-digit code, extends latitudinally 70 to 100 nautical miles and longitudinally from the shoreline out to 200 nautical miles, and includes the other two FG Blocks (Figure 1).

Set gill net vessels fishing halibut also catch other species including white seabass (typically taken with set gill nets, 6.5 inch mesh, set at the same time and in the same general area as halibut nets), sharks and other species. Landings of species other than halibut were variable. In a few instances white seabass landings were greater than halibut landings for a particular year in a particular location. For the purposes of this report, halibut set gill net fishery landings are summarized for halibut only. Value of landings of all species (halibut, white seabass, sharks and other species) in the set gill net fishery are summarized in the Economic and Fiscal Impact Statement.

The proposed closure area is out to 60 fathoms. From Point Reyes to Yankee Point, the majority of the catch is landed in the Port Complex of Monterey. From Yankee Point to Point Sal, the majority of the catch is landed in the Port Complexes of Monterey and Morro Bay. From Point Sal to Point Arguello, the majority of the catch is landed in the Port Complexes of Morro Bay and Santa Barbara. Assigning landings to the proposed closure area out to 60 fathoms is inexact, because the FG Block lines do not match up with all of the boundary lines, and the four-digit FG Blocks encompass

multiple areas (Figure 1). The great majority of the three-digit FG Blocks straddle the 60 fathom line, and for purposes of this analysis, the Department assumed that set gill net catches of halibut in these FG Blocks occurred inside 60 fathoms (California halibut range in depth from the surface to 50 fathoms). The Department also assumed that reports of halibut catches in FG Blocks beyond 60 fathoms were errors. All catches in these FG Blocks were included with the catches in the adjacent proposed closure area. Twelve three-digit FG Blocks straddle the boundary lines at Point Sal and Point Arguello; catches recorded in three-digit FG Blocks (631 - 636 and 643 - 648) were assigned to the Point Sal to Point Arguello area. Catches recorded as having been caught in any of the four-digit FG Blocks (1036, 1037 and 1038) were not used because where fish were caught could not be determined (see Appendix 1 and 2 for catches from FG Blocks 1036, 1037 and 1038).

3.2. Fishing Effort

Information contained in this Section is based on the available landing data for the six-year period 1995 through 2000. The 2001 data were not used because these data were preliminary at the time this report was written and reflect the effect on effort caused by the emergency closures.

3.2.1. Point Reyes to Yankee Point

This area was included in the emergency closures in 2000 and 2001. The 30-fathom gill and trammel net closure south of Point Santa Cruz, Santa Cruz County is not as deep as the closures to the north. As a result, fishermen were still able to catch California halibut, and, according to the NMFS observer program, also caught common murres, a sea otter, and other seabirds and marine mammals. Set gill net fishing for California halibut generally ceased north of Monterey Bay due to the greater closure depths.

From 1995 through 2000, between 11 and 17 vessels (a total of 44 over the six-year period) participated in the set gill net fishery for halibut. Two fishermen fished throughout the year. The remainder of the vessels participated in other fisheries. Vessel participation peaked in 1997 (Table 1). The number of vessels landing less than 1,000 pounds of halibut per year was 10 (1995), 8 (1996), 9 (1997), 4 (1998 and 1999), and 5 (2000). From 1995 through 2000, set gill net landings of halibut averaged 55,972 pounds per year. Halibut landings peaked in 1999 at 110,510 pounds (Table 2). The halibut set gill net fishery had an annual ex-vessel value of approximately $100,493 in halibut landings (Table 2). Over the six-year period, the set gill net landings of halibut from Point Reyes to Yankee Point averaged 5.3 percent of the statewide catch of halibut. Effort in the period has fluctuated, ranging from 76 to 599 landings annually. Effort peaked in 1999 (Table 3). Halibut landings averaged 203 pounds from 1995 to 2000 and peaked in 2000 at 265 pounds (Table 3). Although the

fishery occurs year-round, 63 percent of landings occur from July through September (Table 4).

3.2.2. Yankee Point to Point Sal

This area was not included in the emergency closures in 2000 and 2001. The current regulations prohibit set gill net fishing in waters less than 30 fathoms. The available data suggest that fishing effort was redirected into this area from the closed area to the north and south in 2000, causing a dramatic increase in number of vessels in the fishery and total pounds landed.

From 1995 through 2000, between 7 and 20 vessels (a total of 39 over the six-year period) participated in the set gill net fishery for halibut. Most of these fishermen participated in other fisheries. Vessel participation peaked in 1996 and again in 2000 (Table 1). The number of vessels landing less than 1,000 pounds of halibut per year was 10 (1995), 16 (1996), 12 (1997), 6 (1998), 10 (1999), and 19 (2000). From 1995 through 2000, set gill net landings of halibut averaged 3,668 pounds per year. Halibut landings peaked in 1999 at 4,579 pounds and again in 2000 at 10,299 pounds (Table 2). The halibut set gill net fishery has an annual ex-vessel value of approximately $9,153 in halibut landings (Table 2). Over the six-year period, the set gill net landings of halibut from Yankee Point to Point Sal averaged less than 1 percent of the statewide catch of halibut, except in 2000, when landings totaled 1.23 percent. Effort in the six-year period has fluctuated, ranging from 12 to 57 landings annually. Effort peaked in 1996 and 2000 with 26 and 57 landings, respectively (Table 3). Halibut landings averaged 131 pounds from 1995 to 2000 and peaked in 1999 at 192 pounds (Table 3). The fishery occurs seasonally, with 70 percent of landings from September through March (Table 4).

3.2.3. Point Sal to Point Arguello

This area was included in the emergency closures in 2000 and 2001. Currently there are no set gill net fishery depth restrictions in this area.

From 1995 through 2000, between 3 to 5 vessels (a total of 14 over the six-year period) participated in the set gill net fishery for halibut. Most of these fishermen participated in other fisheries. Vessel participation peaked at five in 1997 and 1999 (Table 1). The number of vessels landing less than 1,000 pounds of halibut per year was 3 (1995), 2 (1996), 4 (1997), 2 (1998), and 3 (1999-2000). From 1995 through 2000, set gill net landings of halibut averaged 1,500 pounds per year. Halibut landings peaked in 1995 at 2,448 pounds (Table 2). The halibut set gill net fishery has an annual ex-vessel value of approximately $4,157 in halibut landings (Table 2). In this period, the set gill net landings of halibut from Point Sal to Point Arguello averaged less than 1 percent of the statewide catch of halibut. Effort in the period has fluctuated,

ranging from four to 13 landings annually. Effort peaked in 1999 with 13 landings (Table 3). Halibut landings averaged 212 pounds from 1995 to 2000 and peaked in 1995 at 350 pounds (Table 3). The fishery occurs when weather allows access to this remote area, typically between February and October, when 90 percent of the landings occurred (Table 4).

4.0. Conclusion

The incidental take of seabirds and marine mammals in the central California set gill net fishery has been documented repeatedly by observer programs in the 1980s and 1990s. The common murre populations of central California are estimated to be between 7 and 22 percent of historical levels. Although the common murre is subject to various restoration and management actions, set gill net entanglements continue to exacerbate the serious impediments to restoration faced by this species.

The southern sea otter is a marine mammal that has been listed as “threatened” under the federal ESA since 1977, has been the subject of a Recovery Plan since 1982, is considered “depleted” under the Marine Mammal Protection Act and is “fully protected” pursuant to Fish and Game Code Section 4700. No level of take is allowed. The southern sea otter population is currently static, and although it is the subject of state and federal protection, set gill net entanglements continue to exacerbate the serious impediments to recovery faced by this species.

Based on the foregoing assessment, the Department believes that, as a direct result of the use of gill and trammels nets, (1) there is a danger of irreparable injury to or mortality in common murres which is occurring at a rate that threatens the viability of the central California population, and (2) the recovery of the southern sea otter is impaired.

INSERT FIGURE 1

INSERT FIGURE 2

INSERT FIGURE 3

INSERT FIGURE 4

Table 1. Annual number of vessels in set gill net fishery for halibut, for the closure area, 1995 to 2000.*

	Pt. Reyes - Yankee Pt.*	Yankee Pt. - Pt. Sal	Pt. Sal - Pt. Arguello*
Year	# Vessels	# Vessels	# Vessels
1995	15	11	4
1996	13	16	3
1997	17	12	5
1998	15	7	4
1999	13	14	5
2000	11	20	4
Average	14	13.3	4.2

* Emergency Order effective 09-11-00 through 01-09-01prohibiting the use of gill or trammel nets in ocean waters which are 60 fathoms or less in depth in an area extending from Pt. Reyes to Yankee Pt. and Pt. Sal to Pt. Arguello.

Table 2. Annual set gill net landings and value (dollars) of halibut, for the closure area, 1995 to 2000.*

	Pt. Reyes - Yankee Pt.*		Yankee Pt. - Pt. Sal		Pt. Sal - Pt. Arguello*	
Year	Pounds	Value	Pounds	Value	Pounds	Value
1995	28,720	55,947	2,249	3,018	2,448	5,885
1996	32,166	72,907	1,971	5,329	1,530	4,711
1997	88,423	133,406	1,842	5,386	1,316	3,585
1998	55,285	95,817	1,071	2,843	652	1,961
1999	110,510	208,789	4,579	11,930	2,221	6,136
2000	20,126	36,606	10,299	26,410	817	2,617
Total	335,230	603,472	22,011	54,916	8,984	24,895
Average	55,871	100,579	3,668	9,153	1,497	4,149

* Emergency Order effective 09-11-00 through 01-09-01prohibiting the use of gill or trammel nets in ocean waters which are 60 fathoms or less in depth in an area extending from Pt. Reyes to Yankee Pt. and Pt. Sal to Pt. Arguello.

Table 3. Number of landings and average landings (pounds) of halibut by set gill net vessels, for the closure area, 1995 to 2000.*

	Pt. Reyes - Yankee Pt.*		Yankee Pt. - Pt. Sal		Pt. Sal - Pt. Arguello*	
Year	# Landings	Ave. Landing (lbs)	# Landings	Ave. Landing (lbs)	# Landings	Ave. Landing (lbs)
1995	172	178	15	150	7	350
1996	184	175	26	76	8	191
1997	341	256	19	97	5	263
1998	340	162	12	89	4	163
1999	599	184	20	192	13	171
2000	76	265	57	181	6	136
Total	1712	1220	149	785	43	1274
Average	285	203	24.8	131	7.2	212

* Emergency Order effective 09-11-00 through 01-09-01prohibiting the use of gill or trammel nets in ocean waters which are 60 fathoms or less in depth in an area extending from Pt. Reyes to Yankee Pt. and Pt. Sal to Pt. Arguello.

Table 4. Six-year average monthly landings by set gill net fishery for halibut, for the closure area, 1995-2000.*

	Pt. Reyes - Yankee Pt.*	Yankee Pt. - Pt. Sal	Pt. Sal - Pt. Arguello*
Month	6-Yr Ave. Mo. Landings (lbs)	6-Yr Ave. Mo. Landings (lbs)	6-Yr Ave. Mo. Landings (lbs)
Jan	2,424	256	0
Feb	1,848	357	94
Mar	1,879	220	172
Apr	849	130	268
May	1,976	144	59
Jun	5,058	73	33
Jul	13,922	126	60
Aug	12,902	61	94
Sep	8,379	196	17
Oct	2,661	221	659
Nov	2,455	486	0
Dec	1,519	1,399	40
Total	55,872	3,669	1,496
Average	4,656	306	125

* Emergency Order effective 09-11-00 through 01-09-01prohibiting the use of gill or trammel nets in ocean waters which are 60 fathoms or less in depth in an area extending from Pt. Reyes to Yankee Pt. and Pt. Sal to Pt. Arguello.

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Appendix 1. Set Gill Net Fishery Landings and Value of California Halibut in Fish and Game Blocks 1036, 1037 and 1038, 1995-2000

Set Gill Net Fishery Landings and Value of California Halibut in Fish and Game Blocks 1036, 1037 and 1038, 1995-2000																
	1995		1996		1997		1998		1999		2000*		6-YR TOTALS		6-YR AVE	
FGB	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$
1036	950	2,753	2,969	8,110	7,292	19,495	5,929	13,395	6,197	15,523	2,575	6,441	25,912	65,717	4,319	10,953
1037	7,722	18,207	20,666	49,106	43,259	76,121	13,552	26,125	17,506	37,673	5,380	9,756	108,085	216,988	18,014	36,165
1038	0	0	0	0	0	0	5,350	2,408	0	0	0	0	5,350	20,408	892	401
Total	8,672	20,960	23,635	57,216	50,551	95,616	24,831	41,928	23,703	53,196	7,955	16,197				

Appendix 2. Set Gill Net Fishery Landings and Value of White Seabass in Fish and Game Blocks 1036, 1037 and 1038, 1995-2000

Set Gill Net Fishery Landings and Value of White Seabass in Fish and Game Blocks 1036, 1037 and 1038, 1995-2000																
	1995		1996		1997		1998		1999		2000*		6-YR TOTALS		6-YR AVE	
FGB	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$	LBS	$
1036	417	1056	100	263	129	356	23666	49916	7025	15912	1258	2916	32595	70419	5432	11736
1037	1218	1778	266	598	2023	3885	365	677	110	276	183	418	4165	7632	694	1272
1038	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	1635	2834	366	861	2152	4241	24031	50593	7135	16188	1441	3334				